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IS 5553-6 (1990): Reactors, Part 6: Earthing transformers (Neutral couplers) [ETD 16: Transformers]

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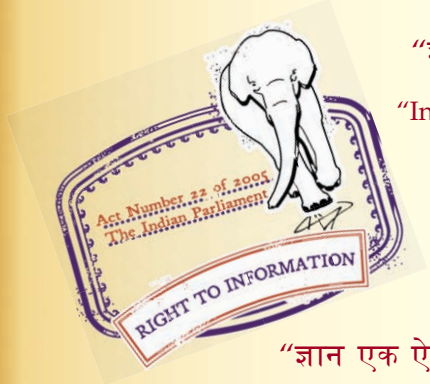

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 5553 (Part 6) : 1990
(Reaffirmed 2001)

Indian Standard

REACTORS — SPECIFICATION

PART 6 EARTHING TRANSFORMERS (NEUTRAL COUPLERS)

(First Revision)

UDC 621·314·228·3

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 1990

Price Group 2

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on 5 January 1990, after the draft finalized by the Transformers Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1970. This revision has been undertaken with a view to bring it in line with the IEC Pub 289 (1988) 'Reactors'.

In this revision the requirements for reactors have been covered in eight parts as follows:

Part 1 General
Part 2 Shunt reactors
Part 3 Current limiting and neutral earthing reactors
Part 4 Damping reactors
Part 5 Tuning reactors
Part 6 Earthing transformers (Neutral couplers)
Part 7 Arc suppression reactors
Part 8 Smoothing reactors

This standard (Part 6) has been based on IEC Pub 289 (1988) Reactors, Section 6 Neutral couplers issued by the International Electrotechnical Commission.

This part shall be read in conjunction with Part 1 of this standard. A list of referred standards is also given in Part 1 of this standard.

This standard (Part 6) supersedes IS 3151 : 1982 'Earthing transformers (*first revision*)' which will be withdrawn with the publication of this standard.

Indian Standard

REACTORS — SPECIFICATION

PART 6 EARTHING TRANSFORMERS (NEUTRAL COUPLERS)

(First Revision)

1 SCOPE

1.1 Earthing transformers covered by this standard (Part 6) are polyphase transformers and used to provide an artificial loadable neutral for earthing of a system at a point where it is otherwise unearthed as follows:

a) By direct earthing; and

b) By connection of earthing reactors, resistors or arc-suppression reactors.

1.1.1 Earthing transformers may be specified with a secondary (low-voltage) winding having a continuous rated power for station auxiliary supply.

NOTE — Earthing transformers may also be used to connect single-phase load between lines and neutral in a system without neutral conductor.

2 TERMINOLOGY

2.0 For the purpose of this standard the following definitions shall apply.

2.1 Rated Voltage

The voltage specified to be applied or developed at no-load between the line terminals of the windings.

NOTE — Unless operating conditions justify the selection of a higher value, the rated voltage is deemed to be the line-to-line voltage of the associated system.

2.2 Rated Neutral Current

The current, flowing through the neutral terminals at rated voltage and rated frequency which the apparatus is designed to carry continuously or for a specified duration.

NOTE — This current is normally a fault current of a short duration. The magnitude, the duration and the fault sequence shall be specified by the purchaser. If necessary, the purchaser may specify a continuous current caused by for example, phase unbalance.

2.3 Rated Continuous Current

The current flowing through the line terminals continuously when a rated power of a secondary winding is specified.

2.4 Zero-Sequence Impedance

The impedance, expressed in ohms per phase at rated frequency, between the line terminal connected together and the neutral terminal IS 1885 (Part 38) : 1977 (*see also* **2.7.6**).

NOTE — The value of zero-sequence impedance may either be left open in the specification or be specified for example when the earthing transformer is used to limit the earth fault current.

2.5 Further Definitions

For further definitions *see* IS 1885 (Part 38) : 1977.

For the purpose of the primary winding with the secondary winding, definitions such as rated power, similar to these for transformers are applicable.

3 RATING

3.1 Rated Voltage of the Main Winding

Unless operating conditions justify the selection of a higher value, the rated voltage shall be equal to the line-to-line voltage of the associated system.

3.2 Rated Neutral Current

The rated neutral current shall be specified to be not less than the highest value of continuous current under service conditions, for example, phase unbalance.

If successive faults occur within a short period of time, the duration, the interval of times, between applications, and the number of applications shall be specified by the purchaser. The rated neutral current shall also be determined as a function of the short-time fault currents.

3.3 Rated Zero Sequence Impedance

The value of zero-sequence impedance may either be left open in the specification or be specified, for example, earthing transformer itself is used to limit the earth fault current.

3.4 Further Ratings

For further ratings *see* **4** of IS 2026 (Part 1) : 1977.

This applies when the earthing transformer is provided with a secondary winding for station service supply or similar purposes.

For the operation of the main winding with a secondary winding, definitions such as rated power, similar to those for transformers are applicable.

3.5 Connections

Earthing transformers are usually connected either in zigzag of star-delta. A delta-connected

winding may be of the open type in order to permit the insertion of a resistor or reactor to adjust the zero-sequence impedance.

4 TEMPERATURE RISE

4.1 Temperature-rise limits shall be as given in IS 2026 (Part 2) : 1977 and **3** and **10** of IS 11171 : 1985.

5 ABILITY TO WITHSTAND THE RATED NEUTRAL CURRENT OR SHORT CIRCUIT CURRENT

5.1 Earthing transformers shall be designed to withstand the thermal and dynamic effects of the rated neutral current.

For earthing transformers with a secondary winding IS 2026 (Part 1) : 1977 is applicable for the ability of the secondary winding to withstand short circuit.

6 INSULATION LEVEL

6.1 The insulation level for the line terminals of an earthing transformers shall correspond to those specified for transformers [*see* IS 2026 (Part 3) : 1981].

For the neutral terminal the selection of a reduced insulation level may be appropriate (Non-uniform insulation).

7 RATING PLATES

7.1 Each earthing transformer shall be provided with a rating plate of weather-proof material, fitted in a visible position, showing the appropriate items as follows. The entries on the plate shall be indelibly marked (for example, by etching, engraving or stamping).

7.2 Information to be given in all cases:

a) Earthing transformers;
b) Number of this specification;
c) Indication of the source of manufacture;
d) Manufacturer's serial number;
e) Year of manufacture;
f) Rated frequency;
g) Rated voltage;
h) Rated neutral current and duration:
i) Connection symbol;
j) Zero-sequence impedance (measured value);
k) Type of cooling;
m) Insulation level;
n) Total mass;
p) Mass of insulation oil;
q) Mass of core and winding assemblies;
r) Number of phases; and
s) In the case of earthing transformers with a secondary winding additional information should be given as for transformers.

7.3 Additional Information to be Given in Certain Cases

Insulation levels of the windings and to its neutral ends if non-uniform insulation.

For further information *see* IS 2026 (Part 1) : 1977.

8 TESTS

8.1 General requirements for type, routine and special tests provisions given in IS 2026 (Part 1) : 1977 shall apply.

8.2 Type Tests

The following shall constitute the type tests:

a) Measurement of winding resistance, [*see* **16.2** of IS 2026 (Part 1) : 1977];
b) Measurement of insulation resistance [*see* **16.6** of IS 2026 (Part 1): 1977];
c) Measurement of zero-sequence impedance (*see* **8.4**);
d) Measurement of no-load loss and no-load current [*see* **16.5** of IS 2026 (Part 1) : 1977];
e) Dielectric tests [*see* IS 2026 (Part 3) : 1981]; In case of earthing transformers with a secondary winding;
f) Measurement of voltage ratio and check of voltage vector relationship [*see* **16.3** of IS 2026 (Part 1) : 1977];
g) Measurement of impedance voltage, short-circuit impedance and load loss [*see* **16.4** of IS 2026 (Part 1) : 1977];
h) Measurement of insulation resistance [*see* **16.6** of IS 2026 (Part 1) : 1977];
j) Dielectric tests [*see* IS 2026 (Part 3) : 1981]; and
k) Temperature-rise tests (*see* **8.5**).

8.3 Routine Tests

The following shall constitute the routine tests:

a) Measurement of winding resistance [*see* **16.2** of IS 2026 (Part 1) : 1977];
b) Measurement of insulation resistance [*see* **16.6** of IS 2026 (Part 1) : 1977];
c) Measurement of zero-sequence impedance (*see* **8.4**);
d) Measurement of no-load loss and no-load current [*see* **16.5** of IS 2026 (Part 1) : 1977];
e) Dielectric tests [*see* IS 2026 (Part 3) : 1981]; in case of earthing transformers with a secondary winding;
f) Measurement of voltage ratio and check of voltage vector relationship (*see* **16.3** of IS 2026 (Part 1) : 1977);

g) Measurement of impedance voltage, short-circuit impedance and load loss [*see* **16.4** of IS 2026 (Part 1) : 1977]; and

h) Measurement of insulation resistance [*see* **16.6** of IS 2026 (Part 1) : 1977].

8.3.1 *Special Tests*

a) Demonstration of ability to withstand short circuit (*see* **8.6**).

8.4 Measurement of Zero-Sequence Impedance

The zero-sequence impedance may be measured preferably at rated neutral current and expressed in ohms per phase. It shall be ensured that the current and the time of application is compatible with the current-carrying capability of the windings or metallic constructional parts. If this condition does not allow the measurement at rated neutral current, any current between 25 percent and 100 percent may be used. The result is to be converted by using an extrapolation method. Type testing at rated neutral current on a similar unit is recommended in order to establish the extrapolation factor.

For the measurement, *see* **16.10** of IS 2026 (Part 1) : 1977.

8.5 Temperature Rise

In the case of short-time service earthing transformers with loading duration not more than 10 seconds the thermal ability is demonstrated by calculation according to **9.1** of IS 2026 (Part 1) : 1977. In other cases, the measurement shall be made in accordance with **4** of IS 2026 (Part 2) : 1977.

When starting the test, the initial value of the top oil temperature shall be the temperature in continuous no-load service or in continuous service with rated power of the secondary winding. The winding temperature after test is as ascertained using the resistance method. The hot-spot temperature rise shall be determined in accordance with IS 6600 : 1972.

8.6 Demonstration of Ability to Withstand Short-Circuit

The ability to withstand thermal effects of short-circuit or rated neutral current is demonstrated by calculation [*see* **9.1** of IS 2026 (Part 1) : 1977].

The ability to withstand the dynamic effects of above-mentioned currents is demonstrated by tests or by reference to tests on similar units.

The tests are carried out on an earthing coupler in new condition and ready for service.

For the test two possibilities of connection are applicable:

— The earthing coupler shall be connected to a symmetrical three-phase supply and a short-circuit shall be established between one phase terminal and neutral.

— The earthing coupler shall be connected to a single-phase supply between the three line terminals connected together and the neutral terminal.

The number of tests shall be two, the duration of each test being $0{\cdot}5 \pm 0{\cdot}05$ s. In the case of earthing couplers intended for direct earthing or earthing with reactors or resistors, the duration of each test will be a specified value such that excessive temperatures of windings and metal constructional parts shall be avoided. The interval between subsequent tests should be sufficient to avoid an undue accumulation of heat.

Otherwise the measurement shall be made in accordance with **9.2** of IS 2026 (Part 1) : 1977.

8.7 Tolerances

Tolerances on zero-sequence impedance measured at rated neutral current shall be $^{+20}_{-0}$ percent of the declared value.

To other quantities when they are the subject of manufacturer's guarantees, for example, voltage ratio, short-circuit impedance, etc, reference should be made to IS 2026 (Part 1) : 1977.

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BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	{ 331 01 31 { 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	41 29 16
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